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Associations between Health Literacy and Attention to Food Packaging, Front of Pack Labels, and Claims

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Associations between Health Literacy and Attention to Food Packaging, Front of Pack Labels, and Claims

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Abstract

Associations between Health Literacy and Attention to Food Packaging, Front of Pack Labels, and Claims

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Background: Poor diet is an important risk factor for chronic disease and obesity in the U.S. and diet related health disparities disproportionately affect race/ethnic minorities and adults with the lowest levels of income, education, and health literacy. Packaged foods contribute to poor diet by adding excess calories, saturated fat, sugars, and sodium. Nutrition labels and claims influence knowledge of the healthfulness and nutrient content of packaged foods, and may ultimately impact purchasing decisions.

Objective: The purpose of this study was to investigate how adults with varying levels of health literacy view food packaging components.

Sample: 25 University Staff and 25 Adult Education students were recruited for participation in the study. The final sample included 47 adults (24 University Staff and 23 Adult Education Students), with 61% of adults were between 25-44 years old, 77% were female, and 47% non-Hispanic White.

Methods: Eye tracking technology was used to measure participant attention to food packaging stimuli. The Newest Vital Sign (NVS) was used to measure health literacy. Using objectively measured attention variables, in linear regression models, this study tested the relationship between health literacy and attention to food packaging, claims, and front of pack labels.

Results: Health literacy was found to be positively associated with attention to food packaging (B = 13.52, SE = *6.06*, $p < .05$) and front of pack labels (B = 0.29, SE = *0.12*, $p < .05$). After controlling for education and race/ethnicity, health literacy remained positively associated with attention to food packaging (B = 17.01, SE = *8.45*, $p = 0.050$) but not with front of pack labels.

Conclusions: Health literacy may be an important factor influencing initial exposure to nutrition information on food packaging. Understanding attention to food packaging and nutrition labels for vulnerable populations, such as those with limited health literacy, is needed to inform strategies focused on increasing nutrition label use and comprehension.

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BACKGROUND

Obesity and Chronic Disease

Five of the fifteen leading causes of death in the U.S. are chronic diseases (Kochanek, Xu, Murphy, Minin˜o, & Kung, 2011). Together, these five diseases, heart disease, cancer, stroke, diabetes, and hypertension accounted for over 57% of all deaths in 2009 (Kochanek et al., 2011) with heart disease accounting for nearly one quarter of these deaths. Although mortality is the ultimate consequence, morbidities such as obesity and heart disease impact quality of life and contribute to difficulties with daily functioning and disabilities (Oreopoulos et al., 2010). According to the 2011 National Health Interview Survey (NHIS), approximately 11% of adults report having heart disease, 24% of adults report having hypertension, and 9% of adults report having diabetes (Sondik, Madans, & Gentleman, 2011).

Obesity is a major risk factor for many of these chronic diseases (Bray, 2003) including heart disease, stroke, and hypertension (Gelber et al., 2008; National Heart Lung and Blood Institute, 1998) diabetes (Gregg, Cheng, Narayan, Thompson, & Williamson, 2007) and certain types of cancer (Polednak, 2008). According to the 2009-2010 National Health and Nutrition Examination Survey (NHANES), 36% of adults in the U.S. were obese (BMI ≥30) (Ogden, Carroll, Kit, & Flegal, 2012). Although the adult obesity rate has increased over the past ten years, the 2009-2010 rate of 36% does not represent a significant change from 2007-2008, possibly reflecting a leveling out of the past trend (Ogden et al., 2012). Obese individuals not only have increased risk for developing chronic diseases, they also have increased risk of mortality resulting from heart disease and obesity related cancers (Flegal, Graubard, Williamson, & Gail, 2007). Further, 70% of adults in the US are considered overweight or obese (BMI ≥25) which

highlights the fact that nearly three-quarters of the population is at elevated risk for largely preventable diseases (Flegal, Carroll, Kit, & Ogden, 2012).

Health Disparities

Rates of obesity and chronic disease are high; however, the burden of disease disproportionately affects adults who have the lowest levels of education, incomes, as well as race/ethnic minorities. In 2010, Hispanic adults and non-Hispanic Black adults were twice as likely to be living at below poverty level as non-Hispanic White adults (Sebelius, Frieden, & Sondik, 2012). According to the 2009-2010 National Health Interview Survey, adults who lived with incomes below 100% of the federal poverty threshold (determined by the 2010 Poverty Guidelines issued by the US Department of State Health Services) were twice as likely to experience two or more chronic diseases than adults who lived at ≥ 400% of the poverty threshold (Sebelius et al., 2012). Hispanic (39%) and non-Hispanic Black (50%) adults also have a higher prevalence of obesity than non-Hispanic White adults (34%) (Flegal et al., 2012). Non-Hispanic Black adults experience severe obesity (BMI ≥35), diabetes, and hypertension at a much higher rate that non-Hispanic White adults (Flegal et al., 2012; Hertz RP, Unger AN, Cornell JA, & E, 2005; Sebelius et al., 2012). In addition to income, educational attainment is also associated with longer life expectancy (Sebelius et al., 2012). Education and socioeconomic status not only impact health but also influence behavioral risk factors for obesity and chronic disease such as diet and physical activity.

Diet as a Behavioral Risk Factor for Obesity and Chronic Disease

Poor diet is a major risk factor for obesity and chronic disease. For example, the associations between sodium intake and hypertension (Roger et al., 2012) and added sugars with obesity (Wang, Steffen, Zhou, Harnack, & Luepker, 2012) have been well established. As a behavioral risk factor, diet is modifiable and therefore a key target for population focused disease prevention (Satia, 2009). Additionally, understanding how demographic and socioeconomic factors influence diet behavior will enhance any population-level action to improve the health status of Americans (Satia, 2009).

The 2012 Dietary Guidelines for Americans emphasize caloric balance, nutrient dense foods, increasing fruits, vegetables, whole grains, lean protein, as well as the reduction of sodium, saturated and trans fat, cholesterol, and calories from added sugars (USDA, 2010). It is clear that few adults meet all components of the dietary guidelines, however, recent analyses from the 2001-2004 National Health and Nutrition Examination Survey (NHANES) indicate that certain subgroups by race/ethnicity and income are at greater risk of poor diet (Kirkpatrick, Dodd, Reedy, & Krebs-Smith, 2012). Adults with low incomes and non-Hispanic Black adults are at greatest risk for not meeting the dietary guidelines (Kirkpatrick et al., 2012).

Fruit and vegetable consumption is strongly associated with a reduction in risk for chronic disease and is regularly measured in the U.S. with surveillance instruments (USDA, 2010). According to the 2005 Behavioral Risk Factor Surveillance Survey (BRFSS) approximately 20% of adult men and 30% of women consumed fruit and vegetables at least five times per day (CDC, 2007b). The 2005 BRFSS also indicated that only one third of adults consumed fruit two or more times per day and consumed vegetables three or more times per day (CDC, 2007a) suggesting that both fruit and

vegetable consumption is lacking. Fruit and vegetable consumption increases with education and income and differs by race/ethnicity (CDC, 2007a; Kirkpatrick et al., 2012; Satia, 2009). Hispanic adults had the highest prevalence of consuming fruit two or more times per day (37%) while non-Hispanic White adults had the highest prevalence of consuming vegetables three or more times per day (29%). Non-Hispanic Black adults were least likely to consume enough vegetables to meet dietary guidelines (Kirkpatrick et al., 2012).

Although increasing fruit and vegetable intake is a key health promotion strategy, limiting sodium, saturated fat, added sugars, and excess calories is equally important (Cohen, Roland, Scott, Farley, & Bluthenthal, 2010). More than 95% of adults across income levels and among all races/ethnicities consume calories from added sugars, saturated fats, and alcohol above the maximum level recommended by the dietary guidelines (Kirkpatrick et al., 2012). It is estimated that 16% of consumed calories come from added sugars (Welsh et al., 2010). Foods containing high amounts of solid fats and/or added sugars often contain high levels of sodium and little to no fiber or other nutrients (USDA, 2010). In a recent cross-sectional study, adults with less education and lower incomes consumed more calories from alcohol, soda, candy, cookies and salty snacks than comparison groups (Cohen et al., 2010). Finally, adults with low incomes spend less money per calorie than wealthier adults, and this low cost-energy ratio is significantly associated with low nutrient density and higher fat content (Appelhans et al., 2012) . These findings indicate that adults with less income and education are at the greatest risk for consuming poor diets.

Processed and Packaged Foods

A major source of excess calories, sodium, saturated fat, and added sugars are packaged and/or processed foods and beverages. Snacking is a common eating behavior among U.S. adults, and with 65% of adults snacking two or more times per day it is also a contributor to excess calories, added sugars, sodium, and saturated fats (Sebastian, Enns, & Goldman, 2011). Alcoholic beverages, sugar-sweetened beverages, savory snacks, candies, cakes and pastries, fruit and fruit juices, dairy desserts, nuts/seeds, cookies, and milk/milk drinks contribute to more than 75% of the calories consumed by adults through snacking (Sebastian et al., 2011).

Empty calories and excess sodium that come from added sugars, salts and fats within processed or packaged foods contribute to poor diet, obesity and chronic disease. Management of discretionary or empty calories as well as limiting saturated fat and sodium are important strategies for maintaining health and weight, achieving weight loss and managing chronic disease. Because packaged foods contribute to poor diet, nutrition information and labeling on food packaging are important factors to consider. Nutrition labels, as well as claims and other food packaging components, can influence an individual's knowledge of the healthfulness and nutrient content of packaged foods. However, more research is needed in order fully establish a clear understanding of how people view nutrition labels, especially in relation to populations with varying levels of education, literacy, and income.

Food and Nutrition Labeling

The Food and Drug Administration (FDA) is largely responsible for the regulation and safety of our food. The Nutrition Labeling and Education Act of 1990 allowed the FDA to require Nutrition Facts Labels on most food packages, as well as regulate nutrient content and health claims on conventional foods and dietary supplements (FDA, 1995). The FDA requires that a Nutrition Facts Label and an ingredients list appear on most packaged food items and also stipulates where and how large the label must appear in relation to the product size (FDA, 2009). There are also requirements for basic Nutrition Fact Label content components, shortened and simplified formats, value rounding and minimum type size. See Figure 1 Nutrition Fact Label (NFL) (FDA, 2009) for a standard example.

Nutrition Facts

Serving Size 1 cup (228g)
Servings Per Container 2

Amount Per Serving	
Calories 260	Calories from Fat 120
	% Daily Value*
Total Fat 13g	**20%**
Saturated Fat 5g	**25%**
Trans Fat 0g	
Cholesterol 30mg	**10%**
Sodium 660mg	**28%**
Total Carbohydrate 31mg	**10%**
Dietary Fiber 0g	**0%**
Sugars 5g	
Protein 5g	
Vitamin A 4% •	Vitamin C 2%
Calcium 15% •	Iron 4%

*Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

Figure 1 Nutrition Facts Label

Any nutrient information that appears on a food package outside the Nutrition Facts Label is considered a Nutrient Content Claim which has specific regulations (FDA, 2009). Examples of Nutrient Content Claims are “low in sugar,” “high in fiber,” and

"zero calorie." FDA requirements for Nutrient Content Claims include: the presence and quantity of nutrients being called out in the claim as well as constraints on the relative size of the claim in relation to the item's identity or title indicating what the food is (FDA, 2009). For example, to have a Nutrient Content Claim that indicates that the product contains "high" amounts of a nutrient, foods must contain at least 20% of the recommended daily intake (RDI) or daily value (DV) of that nutrient (FDA, 2009). Almost 35% of packaged foods contain Nutrient Content Claims (Legault et al., 2004).

Health claims are statements that relate a food or specific food component to a health condition and for which the relationship has significant scientific agreement or research supporting a relationship, determined by the FDA (FDA, 2006). An example of a health claim is "one serving of oatmeal a day can reduce your risk of heart disease." Qualified health claims are claims that do not have significant scientific agreement, and therefore must also include a qualification statement or disclaimer (FDA, 2006). Approximately 5% of all packaged food products contain health claims; however, certain products are more likely to contain health claims, for example, 75% of hot cereals, 24% of snacks, and 13% of cold cereals display health claims (Legault et al., 2004). Structure/function claims do not mention a disease or health condition, but highlight the effect that specific nutrient or food component, for example "calcium helps build strong bones." Approximately 6% of all packaged foods contain a structure/function claim, and specifically, 35 % of cold cereals and 16% of hot cereals display a structure/function claim (Legault et al., 2004). Each of these statements are voluntary and must not mislead the consumer, however, only health claims require petition for approval by the FDA (FDA, 2006).

The impact of the Nutrition Labeling and Education Act of 1990 was found to be mostly positive, demonstrating the importance of providing consumers with complete,

understandable nutrition information at the point of sale (Moorman, 1996). Significant increases were found for the acquisition of nutrition information, label comprehension, and motivation to process nutrition information among Americans after the act (1994) as compared to the time period prior to the act (1993)(Moorman, 1996). However, among less motivated people, the new Nutrition Facts Labels did not increase nutrition information acquisition suggesting limitations on the impact that Nutrition Facts Labels have on people who are not already interested in using nutrition information or labels (Moorman, 1996). This finding suggests that Nutrition Facts Labels have limited efficacy for populations at greatest risk for poor diet.

Broad findings suggest that Nutrition Facts Label use is positively associated with nutrient consumption and negatively associated energy consumption and unhealthy food groups such as saturated fat, and sodium (Campos, Doxey, & Hammond, 2011; Ollberding, Wolf, & Contento, 2010). Further, a recent eye-tracking study, which provides a objective measure of attention, found that participants spent more time viewing nutrition labels for products in which they purchased, linking nutrition label use with food purchasing (Graham & Jeffery, 2012). Improving nutrition label use among adults (18+) was an objective for Healthy People 2000, but the rate remained constant at approximately 75% between 1988 and 2000 (objective was not continued in Healthy People 2010) (NCHS, 2001). According to 2005-2006 NHANES data "62% of adults reported using the Nutrition Facts Labels at least sometimes when deciding to purchase a food product, 52% used the list of ingredients, 48% used serving size, and 44% used health claims" (Ollberding et al., 2010), p. 1234). These findings indicate that, although nutrition label use could be higher, consistently more than half of adults in the U.S. use nutrition labels and use of nutrition labels can influence food purchasing decisions and have important dietary health implications.

Research also suggests that there are disparities in Nutrition Facts Label use. Middle-aged and younger adults, women, more educated, higher income and Caucasian adults are more likely to use nutrition labels (Campos et al., 2011; Ollberding et al., 2010; Petrovici & Ritson, 2006). People with more knowledge of nutrition, nutrition labels and disease-diet relationships were also more likely to report nutrition label use (Campos et al., 2011). Individuals diagnosed with a chronic disease are more likely to report nutrition label use than people without a chronic disease (Campos et al., 2011). Finally, adults with the least amount of education and income are more likely to have trouble interpreting nutrition labels (Cowburn & Stockley, 2005).

One factor influencing how and if adults view or use nutrition labels maybe how easy the labels are to understand. Similar to use of nutrition labels, younger, more educated adults with higher incomes and women are more likely to report and demonstrate understanding of nutrition labels, (Blitstein & Evans, 2006; Campos et al., 2011; Rothman et al., 2006; Sharf et al., 2012). However, many young adults may overestimate their own comprehension (Sharf et al., 2012). Limited, or lack of, numeracy/quantitative skills, to determine values in relation to serving size has been established as a significant barrier to nutrition label comprehension (Campos et al., 2011; Rothman et al., 2006). It is important to highlight that the research summarized above refers to the standard Nutrition Facts Label originally instituted by the FDA in 1994 and does not include other formats such as front of pack labels. This research suggests that an inability to understand information contained in nutrition facts labels could impact how much attention adults give to nutrition information or labels when viewing food packaging. It will be important to determine if presenting nutrition information in simpler formats or in different locations on food packaging impacts adults' attention to nutrition labels.

Front-of-Pack Labeling

Nutrition labels are found to be generally useful and important sources of information, however many studies suggest that consumers are skeptical of claims, desire simpler labeling, and vary greatly in ability to use and comprehend nutrition labels (Campos et al., 2011). Front-of-pack (FOP) labeling has the potential to simplify the standard Nutrition Facts Label in Figure 1 and prominently display it on food packaging with the purpose of increasing consumer attention and comprehension of nutrition information.

In recent years the food manufacturing industry has voluntarily developed and implemented a variety of FOP labeling schemes that are included on packaging in addition to the standard FDA required Nutrition Facts Label. Industry led FOP labeling has resulted from a combination of consumer and marketing research as well as increasing advocacy at the national level for the food industry to take part in combating obesity and other diet related health problems. In 2011, the Grocery Manufacturer's Association instituted the 'Facts Up Front' labeling system in response to positive findings from industry commissioned research on FOP labeling use, comprehension, and consumer comfort level (GMA; International Food Information Council Foundation, 2011). 'Facts Up Front' labels commonly display the calories per serving (the minimum requirement for participation in the initiative), saturated fat, sodium, sugar, and fiber content (GMA). An example of the Grocery Manufacturer Association's FOP label can be found in Figure 2 (GMA). Facts Up Front labels can be seen on Grocery Manufacturer's Association members' food packaging, such as cereal and snack food boxes from General Mills Inc., Kellogg Company, and Safeway Inc. among others.

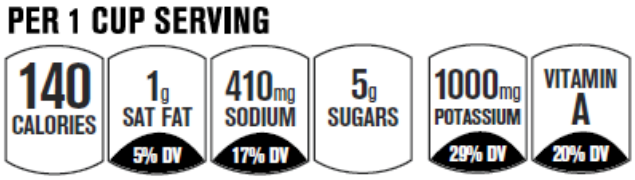

Figure 2 Facts Up Front Nutrition Label, Grocery Manufacturer's Association

Also in 2011, the Grocery Manufacturer's Association in partnership with the Food Marketing Institute announced a program called Nutrition Keys (Brownell & Koplan, 2011). Nutrition Keys is similar to the industry's 2009 Smart Choices program in which products determined to be healthy contained a Smart Choices label; however, Smart Choices was suspended as it met opposition by experts when sugary cereals where set to carry the new health distinction (Brownell & Koplan, 2011).

Coinciding with this industry initiative for FOP labeling, academic researchers and public health institutions are developing a body of research to determine the efficacy of FOP labeling in an effort to guide policy making and standardization of an evidenced based labeling system. A recent review of European literature suggested that adults do have interest in nutrition information on food packaging and may prefer simpler, front of pack labeling formats (Grunert & Wills, 2007). However, there is mixed evidence regarding the efficacy of FOP labeling schemes indicating lack of actual consumer attention to labels and their influence on purchasing behavior (Grunert & Wills, 2007; Roberto, Bragg, Seamans, et al., 2012; Roberto, Shivaram, et al., 2012; Sacks, Rayner, & Swinburn, 2009; van Herpen & Trijp, 2011). Several studies have also found that multiple FOP labeling systems can be problematic for consumers, especially when comparing products (Campos et al., 2011; Draper et al., 2011).

Investigations have also focused on the efficacy of different types of FOP labeling systems. Findings indicate that FOP labels that contain only a healthy or an unhealthy rating, as compared to FOP labels with more detailed nutrition information, resulted in participant selection of healthier items more often (Roberto, Bragg, Seamans, et al., 2012) However, FOP labels on cereal packaging that contained a 'Smart Choices' label plus calories per serving information did increase knowledge, but did not affect perceptions of healthfulness or likelihood to purchase (Roberto, Shivaram, et al., 2012). In another study, traffic light labels (those containing green, yellow, and red to signify healthfulness of the product) out-performed Facts Up Front labels on participant determination of product healthfulness and nutrition content information (Roberto, Bragg, Schwartz, et al., 2012). Findings on the efficacy of FOP labels are mixed, however, research suggests that directive labeling systems may increase consumer comprehension of nutrition label information. Research findings on the influence of claims in conjunction with FOP labeling supports the finding that directive labeling accompanying nutrition information can significantly impact consumer perception of healthfulness of packaged foods (Roe, Levy, & Derby, 1999; Wansink, 2003).

Recent eye-tracking studies have indicated that the location of nutrition label placement as well as directive label schemes impact consumer attention to labels (Graham & Jeffery, 2011; Jones & Richardson, 2007). However, the adults sampled in the Graham & Jeffery 2011 study were predominately Caucasian, held a 4-year college degree, and had incomes greater than $25,000/year. Neither of these studies measured differences by education level, income, or race/ethnicity. More research is needed to determine the efficacy of FOP labeling among these subgroups, especially because they are also more likely to have poor diets and suffer from obesity and chronic disease.

The potential power of FOP labels and claims highlights the importance of standardization in order for consumers to benefit from FOP labeling. According to a recent policy review conducted by the U.S. Department of Health and Human Services, Planning and Evaluation, most industry and field experts call for FOP label standardization (Koehler et al., 2011). For example, it is thought that all FOP labels should at least include saturated fat, trans fat, added sugars and sodium however there is debate about the inclusion of additional categories to include positive nutrients like fiber and healthy fats (Koehler et al., 2011; McGuire & Institute of Medicine, 2012). Given the significant problem with serving size comprehension, experts also agree that any FOP labeling system should be based on only the products' serving size (Koehler et al., 2011; Lando & Lo, 2013). Disagreements exist regarding scoring, symbolization, or color schemes (for example, traffic light colors) designed to assist consumers in determining the healthfulness of a product (Koehler et al., 2011).

It is clear that FOP labeling may be a powerful way to influence adults' attention to important nutrition information. It is also clear that FOP labels, although they may be designed to be simpler and easier to comprehend, may present different challenges for consumer attention and comprehension. More research is needed to determine how adults with varying levels of education and income view FOP labeling in order to inform the standardization of FOP labeling systems (Cowburn & Stockley, 2005; Grunert & Wills, 2007). A deeper understanding of how different populations, especially those at greatest risk for poor diet, will be necessary to maximize impact of FOP labeling, and ultimately consumer diet.

Literacy and Health Literacy

The relationship between low education attainment and poor health outcomes has been well established (DeWalt, Berkman, Sheridan, Lohr, & Pignone, 2004). An important and measurable indicator of education level is literacy. Within the U.S. Department of Education, the National Center for Education Statistics (NCES) is responsible for literacy surveillance and conducts the National Assessment of Adult Literacy (NAAL). The NCES divides literacy into three components: prose, document, and quantitative and rates literacy skills at four levels: below basic, basic, intermediate, and proficient (M Kutner, Greenberg, & Baer, 2005). Among adults who speak English or Spanish, approximately 15% have below basic prose and document literacy and approximately 25% have below basic quantitative literacy (M Kutner et al., 2005). Below basic literacy skills are defined as simple tasks such as signatures or adding numbers whereas comparison, comprehension and calculation tasks are used to define basic skills (M Kutner et al., 2005). Adults without a high school degree were most likely to have below basic literacy skills for all three literacy types (M Kutner et al., 2005).

Although literacy is an important indicator of a person's ability to successfully complete tasks associated with daily living (definition of basic literacy skills (M Kutner et al., 2005)), the application of those skills in context of health-related tasks and activities is a distinct capability referred to as health literacy. Health literacy is a particular type of literacy required for such tasks as communication with healthcare providers, reading medication labels, obtaining online health information, and using nutrition information on food packaging. Health literacy is associated with literacy and education level, and is also influenced by other social factors such as socioeconomic

status and culture (Cooper & Schillinger, 2001). Improving health literacy first became a Healthy People objective in 2010 and continued as a goal for Healthy People 2020 (M. Kutner, Greenberg, Jin, Paulsen, & White, 2006; United States Department of Health and Human Services, 2010). The Institute of Medicine defines health literacy as "the degree to which individuals can obtain, process, and understand the basic health information and services they need to make appropriate health decisions" (Institute of Medicine, 2004), p. 1). This definition was used by the National Center for Education Statistics for the first nation-wide objectively measured health literacy assessment within the 2003 National Assessment of Adult Literacy (NAAL).

According to the 2003 NAAL, more than three quarters of American adults have below proficient health literacy skills (M. Kutner et al., 2006). Within that group, 22% have basic health literacy and 15% have below basic health literacy (M. Kutner et al., 2006). Hispanic, Black, and American Indian/Alaska Native adults and those with less than a high school education were most likely to have below basic health literacy (M. Kutner et al., 2006). The NAAL clearly identifies a large portion of American adults, and specific sub-groups, who do not have the skills necessary to make the best decisions regarding their health.

Limited health literacy is associated with poorer health status (Guzmararian, Williams, Peel, & Baker, 2003; M. Kutner et al., 2006), likelihood of hospitalization (Baker, Guzmararian, & Williams, 2002), and less knowledge about health issues (Guzmararian et al., 2003). Health literacy has also been found to be a partial mediator for the relationship between education status and chronic disease, and education status and perceptions of health risk (Adams et al., 2012; Cooper & Schillinger, 2001). Independent of education and ethnicity, associations between health literacy and diabetes control and resulting health outcomes have also been found to be significant (Schillinger,

Grumbach, & Piette, 2002). In an experimental study, health literacy was found to impact the ability of adults to learn and apply information presented in an educational video on how to read nutrition labels (Jay et al., 2009). Overall, there is strong evidence that health literacy is associated with preventative health behaviors such as diet, alcohol consumption and physical activity (Adams et al., 2012; Carbone & Zoellner, 2012).

Similar to measurement of literacy, there are numerous instruments and tools available to measure health literacy with various strengths and limitations. It is important to note that health literacy is often only functionally defined at a basic level, and does not capture knowledge or skills related to science, technology, or media navigation which are all becoming more and more essential for decision making about health (Zarcadoolas, Pleasant, & Greer, 2005). Even among functional health literacy assessments there is a wide variety, from those that measure comprehension with word recognition such as the Rapid Estimate of Adult Literacy in Medicine (REALM) (Davis TC et al., 1991), to others that also test numeracy or quantitative skills like the Test of Functional Health Literacy in Adults (TOFHLA) (Parker, Baker, Williams, & Nurss, 1995), and Newest Vital Sign (NVS) (McLeod-Sordjan, 2011; Weiss et al., 2005). Health literacy assessments also vary widely in the time required to administer the instrument, from over twenty minutes (TOFHLA) (Parker et al., 1995) to less than five minutes (NVS and REALM-Shortened) (Davis TC et al., 1993; Osborn CY et al., 2007). The NVS instrument is one the quickest functional health literacy assessments that is able to detect limited health literacy (Osborn CY et al., 2007; Weiss et al., 2005). Further, the NVS has been used successfully to test relationships between health literacy and health behaviors such as diet (Adams et al., 2012).

With the development of health literacy assessments that are reliable, valid and easy to administer, a body of research has demonstrated that lower health literacy is

associated with poorer health outcomes and risky health behaviors. However, research has yet to fully understand how health literacy impacts specific preventative health behaviors such as those related to diet. For example, further research is needed to determine how adults with different levels of health literacy view nutrition information and labels on food packaging. Understanding how health literacy impacts diet-related health behaviors can inform public health policy makers, advertisers, and food manufacturers, among others, in efforts to help consumers make accurate decisions that support health.

Literature Summary and Role of Current Study

Research has demonstrated the significance of chronic disease and obesity in the U.S. and has established the importance of diet on these poor health outcomes. National surveillance and public health research has also found significant disparities in diet related health outcomes and their relationships to race/ethnicity, income, education, literacy, and health literacy. Packaged foods significantly contribute to poor diet by adding excess calories, saturated fat, sugars, and sodium to Americans' diets. Important factors influencing purchasing decisions and knowledge of the healthfulness and nutrient content of packaged foods are nutrition labels and claims. Research has demonstrated that adults with the least education are the least likely to use and comprehend nutrition labels.

Recently, simpler and more directive front-of-pack (FOP) labeling schemes have been developed and tested by the food industry and academic researchers. Although the efficacy of FOP labeling systems has yet to be determined there is evidence that different

types, sizes and positioning of nutrition labels on food packaging can influence consumer use and attention. Research has also demonstrated that eye-tracking methodologies can be appropriate for determining attention patterns to nutrition labels and food packaging. However, research has yet to determine how people with varying levels of literacy or health literacy view nutrition labeling and claims. Further, the effect of front-of-pack labeling schemes on attention to nutrition information among groups with varying health has yet to be explored.

Due to the high prevalence of health disparities regarding diet and diet related health outcomes, it is imperative that steps are taken to encourage and facilitate healthy diets among adults most at risk for poor diet. Nutrition labels may be a part of the solution; however we must first understand how diverse groups view nutrition information on food packaging. This project seeks to contribute to the body of research focused on increasing our understanding of how people with different levels of health literacy view nutrition information on packaged foods.

PURPOSE

The purpose of this study was to investigate how adults with varying levels of health literacy view food packaging components. Using objectively measured attention variables, this study tested the relationship between health literacy and attention to food packaging, claims, and front of pack labels.

Hypotheses

Broadly, it is hypothesized that health literacy is associated with attention to food packaging, claims, and front of pack labels. It is specifically hypothesized that adults with limited health literacy will pay less attention to front of pack labels than adults with adequate health literacy. However, given the simple layout of front of pack labeling schemes, as compared to standard back of pack labeling, it is also hypothesized that there will be fewer differences in the amount of attention paid to FOP labels among adults with adequate and limited health literacy. Further, given the powerful influence of health claims, it is hypothesized that adults with limited health literacy may pay more attention to claims than adults with adequate health literacy.

STUDY DESIGN

This thesis project is a part of a larger study titled: *Eye Tracking and Health Literacy: Exploring Differences in the Intake of Information.* The goal of the larger three component study was to investigate the relationship between health literacy and how adults view health related information or advertisements. All participants were run through all three components, including an initial set of demographic and survey questions. The first component consisted of a health literacy assessment using the Newest Vital Sign instrument in which participants were asked to view a nutrition label and answer a series of six questions about the label. During the second component participants were asked to view series of health related advertisements and answer a series of four questions about each advertisement. The third, and last, component directed participants to view a series of images of food packages and food and beverage related advertisements. This thesis project is focused on participant attention to the food packaging stimuli presented in the third component of the larger study and its relationship to health literacy.

Participants

In order to compare adults with different health literacy levels, two populations likely to have different literacy levels were identified for participant recruitment. Staff members from the University of Texas (University Staff) were determined to be a population with at least basic literacy. Adult students enrolled in an adult basic education and literacy agency (Adult Education Students) were expected to have low literacy levels.

All participants were required to understand and speak English fluently and be over 18 years old. A total of 50 participants were recruited, 25 from each group.

University Staff were recruited through a university sponsored online event calendar that included a short description of the study. The ad included requirements for participation: ability to understand and speak English fluently and be a UT Staff member, receipt of a $40.00 grocery store gift card upon completion of the study, and approximate time commitment (a 30 minute session). University Staff were instructed to email the study staff expressing interest in the study and a graduate student responded with available times to set-up a study session with a participant. A total of 25 university staff were recruited.

Adult Education Students were recruited from the adult basic education and literacy agency. Instructors and staff from the agency announced the opportunity for students to participate in the study during class (and included information about the study's requirements: ability to understand and speak English fluently and be an Adult Education Student, receipt of a $40.00 grocery store gift card upon completion of the study, and an approximate 30 time commitment). Instructors provided a sign-up sheet with 30 minute study session time slots. A total of 25 students signed up to participate.

Procedure

All eye-tracking study sessions for University Staff were administered in a university building office with a single graduate assistant as the study administrator. Study sessions for Adult Education Students were conducted at the education agency

building in a closed office, also with a single graduate student. All participants were seated in a stationary chair and asked to turn off or silence their cell phones.

Research assistants used a script to ensure that each study session was administered in the same way for all participants. University Staff participants were asked to show University Staff ID to verify employment at the university. Students were not asked to show ID because study sessions were conducted at the education agency where students participated during breaks from class time.

Protocol:

1. Participants were greeted and invited to sit in front of the eye tracker screen next to the research assistant in a chair without wheels. The Research assistant then read aloud the consent form (see Appendix A: Oral Consent Script) briefly describing the study and length of study session. Participants were made aware that their participation was completely voluntary and they should feel free to say "pass," or "I don't know," to any question presented in the study in which the participant did not feel comfortable answering or did not know the answer. They were also reminded that upon completion of the study session they would be given a $40.00 grocery store gift card as compensation for their time and a copy of the consent form. After the research assistant addressed any questions, participants were then asked to agree orally to participate in the study.
2. Participants were then asked to orally answer a series of demographic and survey questions (See Appendix B: Measures) that the research assistant entered into a computer.

3. Participants were then directed to face the screen and find a comfortable position that they could keep for approximately the next twenty minutes without significantly changing position. The eye tracking calibration process was then explained. Participants were asked to follow, with their eyes, a series of dots on the eye tracker screen. Recalibration was completed as needed.
4. Once participants were calibrated to the eye-tracker they were asked to keep their gaze towards the screen. The first component of the study session then began with the Newest Vital Sign health literacy assessment.
5. During the second component participants were instructed to view a series of health-related advertisements at their own pace and then orally answer four subjective questions regarding each image. (This stimulus was not part of this thesis project.)
6. A transition screen then appeared on the screen and participants were asked, for the last component, to click through a series of images as if they were shopping at a grocery store at their own pace. This third section included images of food packaging and food and beverage related advertisements. (Only food packaging images are included as a part of this thesis project.)
7. When the last section was complete participants were asked if they had any questions about the session or study and then given the grocery store gift card and consent form.

Food Packaging Stimuli

A total of 37 images of food packaging were included in the eye-tracking session. Stimuli included images of the front side package of cereals, pasta, snacks, bottled juice, and candy. Four images also included the standard Nutrition Facts Label adjacent to the front of package image. Figure 3 is an example of the food package stimuli used in the present study.

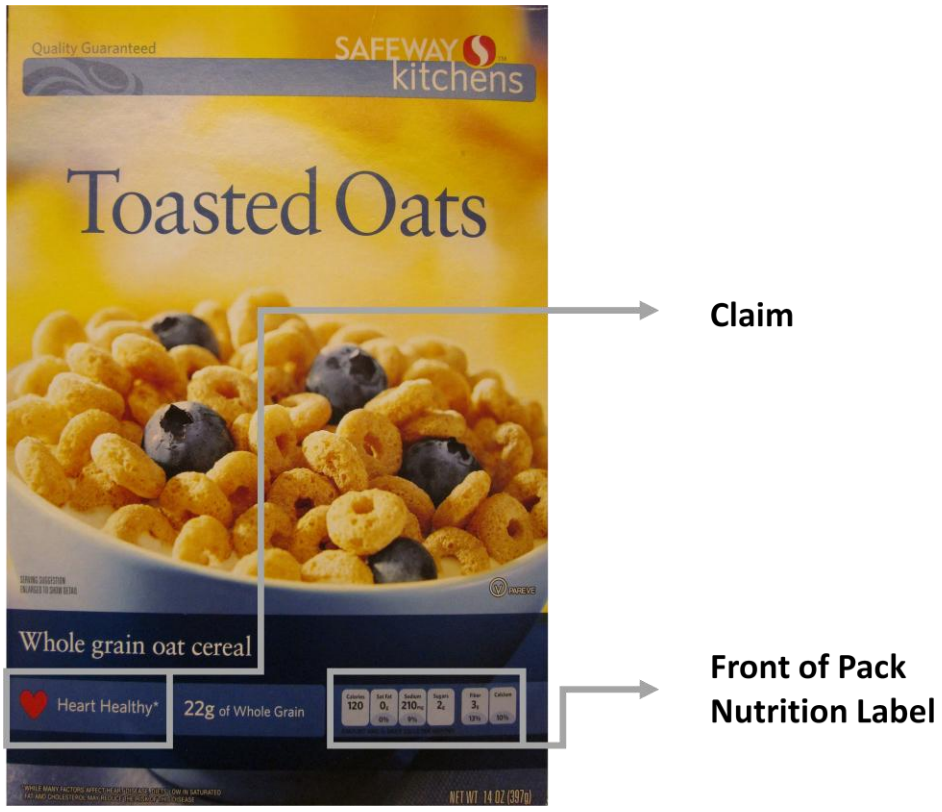

Figure 3 Food Package Stimuli

MEASURES

Demographics and Survey Questions

Participants were asked demographic and survey questions orally by the research assistant at the beginning of the study session and entered into a computer. Participants were not read choices. The following demographic information was recorded: education and race/ethnicity (see Appendix B: Measures). Education and race/ethnicity were coded as dichotomous variables. Education was coded as the attainment of a 4 year college degree or higher or having less than a 4 year college degree. Race/ethnicity was coded as white or non-white.

Health Literacy, Newest Vital Sign (NVS)

The NVS instrument was developed by Weiss and colleagues for use by primary care physician offices to quickly assess patient health literacy levels (Weiss et al., 2005). The Newest Vital Sign (NVS) requires subjects to view a nutrition facts label and answer six questions about the label, testing literacy and numeracy skills. The NVS is available in both English and Spanish that can be delivered in approximately five minutes (NVS) (Weiss et al., 2005). The NVS score represents the number of questions answered correctly. A score of 4 or above indicates adequate health literacy where a score of less than 4 may indicate limited health literacy (Weiss et al., 2005). A further study supports that the NVS is an appropriate tool, with both internal and external validity, for assessing adult health literacy (Ryan et al., 2008). The NVS can be found in Appendix B: Measures.

The NVS was chosen to measure health literacy in this study for several reasons. Assessing health literacy using a nutrition label enables measurement of literacy and numeracy skills specifically related to viewing food packaging, claims, and front of pack nutrition labels. Further, in order to assess differences in attention to food packaging features by health literacy level, the ability to detect variation in health literacy was required. The NVS tool has been shown to detect adequate and limited health literacy (Osborn CY et al., 2007; Weiss et al., 2005). The visual and quick nature of this assessment allowed for its seamless integration into the study procedure. Participant Newest Vital Sign scores were used in regression analyses as interval data to test the association between health literacy and attention to food packaging, claims, and front of pack labels.

Attention Measures (Eye Tracking)

Tobii Eye Tracking software was used to measure visual attention to specific features of study stimuli, food packaging images. Broadly, eye tracking is used to study visual attention with the assumption that visual attention indicates cognitive recognition and/or processing (Duchowski, 2007; (Tobii Technology, 2012)). In layman's terms eye tracking allows us to understand what participants look at which may be indicative of what they find interesting or confusing (Duchowski, 2007). It is important to emphasize that eye-tracking alone does not explain why participants fixate on certain areas of the image.

Our visual field is made up of two regions: the largest parafoveal region which is our "peripheral"/ out-of-focus vision and the foveal region comprising what is in focus and represents a much smaller percentage of our field of vision (Duchowski, 2007; (Tobii Technology, 2012)). The foveal region comprises approximately fifty percent of the information that gets transmitted to the brain through the optical nerve (Duchowski, 2007; (Tobii Technology, 2012)). From all of the visual stimuli that we are exposed to, selectively, we filtered certain items into the foveal region and pause, in order to see something in focus and more detail (Duchowski, 2007; Tobii Technology, 2012). This selective placement of certain stimuli features in the foveal region and the corresponding pause is known as fixation. The length of time spent with a specific item or region of the stimuli in the foveal region become the eye movements tracked as fixation length data (Tobii Technology, 2012). In eye-tracking research it is assumed that stimuli placed in the foveal region, for fixation length data, is related to visual attention.

Using the Tobii eye tracking software certain features of the study stimuli were coded to enable the collection of fixation length data on a particular feature of the food package. These features are called areas of interest. The fixation length data on the particular areas of interest create attention variables. Attention variables measured in this study included: attention to food packaging, claims, and front of package nutrition labels.

ATTENTION VARIABLES

Attention to food packaging was defined as the fixation length on the entire image of the food package including all components displayed on the front of the food package.

Attention to claims was defined as fixation length on any word, phrase, or graphic with numbers present on the front of the food package that was not explicitly a brand or logo, front of package nutrition label, picture, cartoon, coupon or school box top, product title or description, or net weight.

Attention to front of package nutrition labels was defined as fixation length on any rectangular or square shaped nutrition label graphic present on the front of the food package contain at least one number.

DATA ANALYSIS

Descriptive statistics were run on all variables and checked for skewness and kurtosis. Variables with skewness values greater than 2 and/or kurtosis values greater than 7 were square-root transformed. The only variable determined to have a skewness or kurtosis value outside of this range was attention to front of pack labels. After the variable was transformed it fell within the normal range.

Independent Sample T-Tests were used to test mean differences for health literacy and attention variables between the University Staff and Adult Education Student groups. Because no significant differences were found for group membership, further regression analyses were tested with the groups combined. Unadjusted linear regression models were then used to test the relationships between health literacy and attention to food packaging, claims, and front of pack labels. Each model was then adjusted, controlling for education level and race.

All models were run with the square root transformed variable and un-transformed variables.

RESULTS

Demographic Characteristics

A total of 50 adults consisting of 25 University Staff and 25 Adult Education Students participated in the study. Data was not recorded properly due to technological malfunction for three participants (1 University Staff and 2 Adult Education Students) so they are not included in the following analyses, therefore the sample of the present study is 47 (24 University Staff and 23 Adult Education Students). For the overall sample (n=47) 61% of adults were between 25-44 years old, 77% were female, and 47% were non-Hispanic White (see Table 1).

Table 1 Sample Demographic Characteristics by Study Group

(University Staff and Adult Education Student)

	Total (n=47)		University Staff (n=24)		Adult Education Student (n=23)	
Measures	**Count**	**%**	**Count**	**%**	**Count**	**%**
Gender						
Female	36	76.6%	21	87.5%	15	65.2%
Age						
18-24 years	6	12.8%	2	8.3%	4	17.4%
25-34 years	18	38.3%	8	33.3%	10	43.5%
35-44 years	13	27.7%	10	41.7%	3	13.0%
45-54 years	6	12.8%	3	12.5%	3	13.0%
55-64 years	4	8.5%	1	4.2%	3	13.0%
Race						
White	22	46.8%	17	70.8%	5	21.7%
Non-White	25	53.2%	7	29.2%	18	78.3%
Education						
≤ 4-year college degree	28	59.6%	5	20.8%	23	100.0%
≥ 4-year college degree	19	40.4%	19	79.2%	0	
Income						
Less than $10,000	15	31.9%	1	4.2%	14	60.9%
$10,000-$19,000	3	6.4%	0		3	13.0%
$20,000-$29,000	6	12.8%	1	4.2%	5	21.7%
$30,000-$39,000	10	21.3%	9	37.5%	1	4.3%
$40,000-$49,000	6	12.8%	6	25.0%	0	
$50,000-$59,000	6	12.8%	6	25.0%	0	
$60,000-$69,000	1	2.1%	1	4.2%	0	

Health Literacy and Attention Descriptive Statistics

The average Newest Vital Sign (NVS) score indicating health literacy for the sample overall (n=47) was 3.91. The NVS measures health literacy with six questions

where a score of six indicates six correct answers. A score of 4 or more on the NVS indicates adequate health literacy, whereas a score of less than 4 indicates limited health literacy (Weiss et al., 2005). The average time spent viewing food packaging was 147.38 seconds or approximately 2 minutes and 45 seconds, however, attention time varied widely among participants (standard deviation for the sample overall was over 90 seconds).

Using independent samples T-Tests, the present study tested for differences in health literacy and attention between the two groups, University Staff and Adult Education Students. The University Staff group on average spent more time viewing food packaging, claims, and front of pack labels; however, mean differences were not significantly different. The mean health literacy scores for the University Staff group and the Adult education group were significantly different ($p < 0.001$).

Table 2 Health Literacy and Attention Descriptive Statistics by Study Group

	Total (n=47)	**University Staff (n=24)**	**Adult Education Student (n=23)**
Measures	***m* (SD)**	***m* (SD)**	***m* (SD)**
Newest Vital Sign Score (NVS)	3.91 (2.15)	5.54 (.66)***	2.22 (1.81)***
Attention to food packaging (seconds)	147.38 (91.92)	159.88 (94.61)	134.35 (89.22)
Attention to claims (seconds)	29.23 (25.63)	31.58 (24.99)	26.78 (26.60)
Attention to front of pack labels (seconds)	6.43 (10.21)	8.63 (12.51)	4.13 (6.59)

*** $P < 0.001$

Given that there were no significant differences in attention between University Staff and the Adult Education Students, but a significant difference in health literacy between the two groups, the present study tested for differences in attention by health literacy. Using independent samples T-Tests, participants with adequate health literacy (NVS scores equal to or greater than 4) spent more time viewing front of pack labels than participants with limited health literacy (NVS scores less than 4) ($p < .05$). No significant differences were found for attention to food packaging or claims by health literacy level.

Table 3 Attention Variables Descriptive Statistics by Health Literacy

Newest Vital Sign (NVS)

	Total (n=47)	**NVS ≥ 4 (n=31)**	**NVS < 4 (n=16)**
Measures	***m* (SD)**	***m* (SD)**	***m* (SD)**
Attention to food packaging (seconds)	147.38 (91.92)	165.58 (92.41)	112.13 (82.59)
Attention to claims (seconds)	29.23 (25.63)	33.06 (26.15)	21.81 (23.61)
Attention to front of pack labels (seconds)	6.43 (10.21)	8.19 (11.36)*	3.00 (6.44)*

* $P < 0.05$

Unadjusted Analyses: Health Literacy and Attention to Food Packaging Components

Regression analyses were conducted to test the association between health literacy and attention to food packaging, claims, and front of pack labels. For food packaging, results indicated that for each one point increase in the NVS score participants spent an

additional 13.52 seconds fixating on food packaging (B = 13.52, SE = 6.06, $p < .05$). This finding indicates that greater levels of health literacy were associated with greater levels of attention to food packaging. Similarly, the association between health literacy and attention to front of pack labels was also found to be significant (B = 0.29, SE = 0.12, $p < .05$). This means that for each one point increase in the NVS score participants spent an additional 0.29 seconds fixating on front of pack labels. The association between health literacy and attention to claims was not significant (B = 2.98, SE = 1.73, $p > .05$).

Adjusted Analyses: Health Literacy and Attention to Food Packaging Components

When controlling for education and race, health literacy remained significantly associated with attention to food packaging (B = 17.01, SE = 8.45, p = 0.050). For each one point increase in the NVS health literacy score, participants spent an additional 17.01 seconds fixating on food packaging.

Similar to the unadjusted analyses, when controlling for education and race, health literacy was not significantly associated with attention to claims (B = 3.91, SE = 2.40, $p > 0.05$). However, in the adjusted analyses health literacy was no longer associated with attention to front of pack labels (B = 0.31, SE = 0.16, $p > 0.05$).

DISCUSSION

Supporting previous research findings that adults with higher levels of education use nutrition labels more often than less educated adults (Campos et al., 2011; Ollberding et al., 2010; Petrovici & Ritson, 2006), this study found that adults with adequate health literacy spent more time viewing front of pack nutrition labels than adults with limited health literacy. This suggests that 'Facts up Front' style front of pack labeling (present in this study's stimuli) may not significantly impact attention to nutrition labels for adults with limited health literacy. More research is needed to determine if certain front of pack labeling characteristics, such as directives or interpretation aids (such as traffic light color schemes), size or location could impact attention to front of pack label in populations with low health literacy.

After controlling for education level and race/ethnicity the association between health literacy and attention to food packaging was the only relationship to remain significant. This finding suggests that above and beyond demographic factors (education and race/ethnicity) determined in previous research to influence attention to nutrition labels, health literacy is significantly associated with attention to food packaging. This finding supports research that has found health literacy to be an indicator of poor health behaviors (Adams et al., 2012; Carbone & Zoellner, 2012; Jay et al., 2009) because less attention to food packaging may decrease the likelihood of viewing food packaging components such as nutrition labels. Broadly, this suggests that health literacy may be an important factor influencing how adults initially view and perceive food packaging.

Attention to food packaging and its components (i.e. claims and front of pack nutrition labels) must be considered as part of the process resulting in use and comprehension. Grunert and Wills have published a useful theoretical framework that can be applied to how consumers are exposed to nutrition information on food packaging. For example, consumers perceive of information which then influences their liking and understanding of that information and ultimately their use and application of that information (Grunert & Wills, 2007). Factors such as previous nutrition knowledge, demographics, and label format can impact initial exposure and further processes (Grunert & Wills, 2007). The present study specifically focused on factors, like health literacy, that influence initial exposure to front of pack nutrition labels on food packaging and its resulting impact on perception, as measured by attention.

Adults with limited health literacy were found to spend less time viewing food packaging than adults with adequate health literacy. Follow-up studies could investigate what factors are associated with increased perception of food packaging components such as graphics and colors, as well as how these factors may also distract from or compete with front of pack nutrition labels. The goal of this research would be to determine if front of pack label formats or food packaging design elements could be used to overcome the attention disparity by reducing the time and effort necessary to find and comprehend nutrition information in the label.

While efforts to increase attention to food packaging may increase the likelihood of exposure to nutrition labels on food packaging, it is unlikely that this will result in healthier food choices if adults with limited health literacy are unable to comprehend

nutrition labels once they are viewed. However, further research focused on nutrition label use and comprehension must take into account that exposure to information on food packaging may be reduced for people with limited health literacy.

The present study has several strengths. A significant gap in nutrition label research is the inclusion of diverse populations in study samples. One of the primary goals of this study was to better understand how adults with different levels of literacy, specifically health literacy, view food packaging, claims and front of pack nutrition labels. Using, objectively measured eye tracking data from adults with adequate and limited health literacy the present study was able to compare differences in attention to food packing, claims, and front of pack labels for adults with varying health literacy. This study contributes to important research focused specifically on vulnerable populations by providing evidence supporting the relationship between health literacy and attention to food packaging.

Health literacy is emerging as an important indicator for health behaviors and outcomes. Using the Newest Vital Sign (NVS) tool, this study was able to detect variation in health literacy among study participants. Supporting prior research on the association between health literacy and preventative health behaviors (Adams et al., 2012; Carbone & Zoellner, 2012), this study found that health literacy was positively associated with attention to food packaging. This may suggest that, due to limited attention to food packaging in general, adults with limited health literacy may be less likely to view or read features on food packaging such as a nutrition label. The

successful application of the NVS supports future use of this tool for examining the relationship between health literacy and other health behaviors.

This study also contributes to the limited, but fast growing, body of research focused on the efficacy of front of pack labeling. As policy officials with the Institute of Medicine move closer to recommendations for the standardization of front of pack labeling systems (McGuire & Institute of Medicine, 2012) this eye tracking study can inform efforts to improve attention to nutrition information on food packaging. Research, such as the present study, focused on populations with the greatest risk for poor diet and related health outcomes are also needed to inform polices and recommendations regarding front of pack label standardization.

While this study has many strengths, there are also limitations. The attention variables refer to fixation length on a particular area of the food package (whole food package, claim or front of pack label), however it is not possible to determine the reason for fixation. Fixation or attention to a particular area of the food package such as a front of package label could indicate participant interest in that feature, confusion about that feature, or something entirely different. Further, participants were simply asked to view the images of food packaging at their own pace without a specific task or objective. While this enabled the study to distinctly investigate attention, it is not possible to determine if food packaging, claims or front of pack labels were consciously perceived. Future research utilizing eye tracking technology could incorporate a questionnaire asking study participants to recall the types of nutrition labels or information they saw while viewing food packaging which would assist researchers in distinguishing between

attention and perception. Beyond perception, eye tracking studies involving tasks, such as reading and answering questions about a front of pack nutrition label, could then explore the relationship between attention and comprehension.

The study stimuli (images of food packaging see Figure 3) also have limitations. Due to the time required to administer eye tracking study sessions there was a limited number of study images that could be included in order minimize participant time commitment. The limited number of study images allotted for this study did now allow for the inclusion of all types of food package information and nutrition labels available to the consumer in the real world. For example health claims or structure function claims were not included in the study images. Given the high prevalence of claims on food packaging, future research could determine the extent to which different types of claims influence attention to front of pack nutrition labels.

Similar to other eye tracking studies, particularly stationary studies conducted with static stimuli on a computer screen, this study may not generalize well to real world situations. The manner in which participants view images of food packaging may be different then the way adults view actual food packages in a grocery store while shopping. Still, stationary eye-tracking methods present a unique way to efficiently and cost-effectively examine attention to food packaging, especially for a new and quickly changing field of research.

Implications

This study found that adults with adequate health literacy pay more attention to front of pack nutrition labels than adults with limited health literacy, and that health literacy is positively associated with attention to food packaging. These findings support related research that has found positive relationships between education and nutrition label use (Campos et al., 2011; Ollberding et al., 2010; Petrovici & Ritson, 2006). Previous research has also found that nutrition label use is associated with nutrient and healthy food group consumption (Campos et al., 2011; Ollberding et al., 2010), which highlights the importance of strategies aimed at increasing nutrition label use among adults with low health literacy and/or limited education, as this group is at the highest risk for poor diet. Adults with the least amount of education and health literacy are not only at the greatest risk for poor diet, but also obesity and chronic disease (Adams et al., 2012; Appelhans et al., 2012; Carbone & Zoellner, 2012; Cohen et al., 2010; Kirkpatrick et al., 2012; Sebelius et al., 2012). These disparities elevate the importance of future research aimed at understanding how these vulnerable populations view food packaging and nutrition information.

The present study found that attention to food packaging for adults with limited health literacy was significantly shorter than adults with adequate health literacy suggesting that health literacy level may be a barrier to nutrition label attention, deterring possible nutrition label use. Future studies are needed to determine to what extent attention to nutrition labels and information is influenced by food packaging design elements and/or awareness and motivation regarding healthy dietary habits. Efforts to

simplify nutrition labels and increase their visibility, as seen in the 'Facts Up Front' label (GMA), may have limited efficacy if upstream factors like health literacy or awareness of the importance of healthy eating reduce initial exposure and attention. Addressing disparities in attention to food packaging and nutrition labels may require a dual approach: one focused on designing nutrition labels that are eye catching and simple enough to comprehend (especially as the field moves towards standardization) and another focused on improving health literacy skills that enable effective navigation of nutrition information. Further health promotion strategies geared towards increasing knowledge and awareness of the link between chronic disease and diet are necessary to address motivation to make healthy food choices in low health literate populations.

The present study's findings can be used to inform future improvements in front of pack labeling systems and may give insight into the role that health literacy plays in the initial perception of nutrition information on food packaging. Attention to food packaging and nutrition information forms the basis on which comprehension takes place and educated decisions can be made for healthy packaged food choices; however, this study demonstrates the need for further investigation into the factors that influence initial exposure and attention. Consumption of a healthy diet is one of the most important health behaviors for preventing obesity and chronic disease. Therefore, it should be the goal of research and policy on food packaging and nutrition labeling to make nutrition information accessible to everyone regardless of health literacy or education level; which, will in turn support the efficacy of health promotion strategies designed to educate and motivate adults to use nutrition information to make healthier choices.

APPENDICES

APPENDIX A: ORAL CONSENT SCRIPT

As a person utilizing services of (Group A - The Austin Academy) OR (Group B - As a staff member at the University of Texas at Austin) you are being invited to participate in a research study to investigate the understanding of health information. Researchers at The University of Texas at Austin will perform the study. Participation in this study is completely voluntary. Your decision to participate or not participate will in no way affect the services you get from The Austin Academy. You may refuse to answer any questions you do not feel comfortable answering by saying "pass" and you may leave the study at any time. There are no known physical, psychological, social, or legal risks to participating in this study, and benefits include the chance to learn information about a health topic and contribute to research.

If you decide to take part in this study, you will be asked to consent to the following. First, you will be asked to view a series of pictures using the eye tracking monitor. This piece of equipment measures your eye movements while you look at the pictures presented. Some of these pictures will include questions with them or immediately after them. This entire research activity should take approximately 30 minutes.

Everything you say will remain confidential with only the investigator and the research team having access to the data collected for this project; no personally identifiable information will be collected and your name will not be connected to the data

you provide. Upon completion of the study you will be given a $40 gift card to HEB grocery store.

If you have any particular questions about this study, please contact the investigator, Michael Mackert, Ph.D., at 512-471-8558. This study has been reviewed and approved by The University of Texas at Austin Institutional Review Board. If you have questions about your rights as a study participant, or are dissatisfied at any time with any aspect of this study, you may contact - anonymously, if you wish - the Institutional Review Board by phone at (512) 471-8871 or email at orsc@uts.cc.utexas.edu.

If you agree to participate, please respond "I agree" at this time.

You will be given a copy of this information to keep for your records.

APPENDIX B: MEASURES

Demographic Questions:

What is your race/ethnicity?

Non-Hispanic White

Hispanic

Non-Hispanic Black

Asian American/Pacific Islander

American Indian/Alaskan Native

Other

What is the highest level of education you have completed?

Less than high school

High school/GED

Some college

2-year college degree (Associate's)

4-year college degree (BA, BS)

Master's degree

Doctoral degree

Professional degree (MD, JD)

Health Literacy Assessment: Newest Vital Sign
Ice cream label (below) was presented.

Figure 1A. The newest vital sign — English.

Nutrition Facts	
Serving Size	1/2 cup
Servings per container	4
Amount per serving	
Calories 250	Fat Cal 120
	%DV
Total Fat 13g	20%
Sat Fat 9g	40%
Cholesterol 28mg	12%
Sodium 55mg	2%
Total Carbohydrate 30g	12%
Dietary Fiber 2g	
Sugars 23g	
Protein 4g	8%

* Percent Daily Values (DV) are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

Ingredients: Cream, Skim Milk, Liquid Sugar, Water, Egg Yolks, Brown Sugar, Milkfat, Peanut Oil, Sugar, Butter, Salt, Carrageenan, Vanilla Extract.

Note; This single scenario is the final English version of the newest vital sign. The type size should be 14-point (as shown above) or larger. Patients are presented with the above scenario and asked the questions shown in Figure 1b.

This information is on the back of a container of a pint of ice cream.

If you eat the entire container, how many calories will you eat?

If you are allowed to eat 60 g of carbohydrates as a snack, how much ice cream could you have?

Your doctor advises you to reduce the amount of saturated fat in your diet. You usually have 42 g of saturated fat each day, which includes 1 serving of ice cream. If you

stop eating ice cream, how many grams of saturated fat would you be consuming each day?

If you usually eat 2500 calories in a day, what percentage of your daily value of calories will you be eating if you eat one serving?

Pretend that you are allergic to the follow substances: Penicillin, peanuts, latex gloves, and bee stings.

Is it safe for you to eat this ice cream?

(Ask only if the patient responds “no” to above question): Why not?

Of the ingredients shown in the ice cream, which ingredient is there the most of?

(Weiss et al., 2005)

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